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One-step hydrothermal synthesis of three-dimensional porous graphene aerogels/sulfur nanocrystals for lithium-sulfur batteries

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ABSTRACT

Lithium-sulfur (Li-S) batteries are receiving significant attention as a new energy source because of its high theoretical capacity and specific energy. However, the low sulfur loading and large particles (usually in submicron dimension) in the cathode greatly offset its advantage in high energy density and lead to the instability of the cathode and rapid capacity decay. Herein, we introduce a one-step hydrothermal synthesis of three-dimensional porous graphene aerogels/sulfur nanocrystals to suppress the rapid fading of sulfur electrode. It is found that the hydrothermal temperature and viscosity of liquid sulfur have significant effects on particle size and loading mass of sulfur nanosrystals, graphitization degree of graphene and chemical bonding between sulfur and oxygen-containing groups of graphene. The hybrid could deliver a specific capacity of 716.2 $mAh \cdot g^{-1}$ after 50 cycles at a current density of 100 $mA \cdot g^{-1}$ and reversible capacity of 517.9 mA $h \cdot g^{-1}$ at 1 $A \cdot g^{-1}$. The performance we demonstrate herein suggests that Li-S battery may provide an opportunity for development of rechargeable battery systems.

***Keywords*:** hydrothermal synthesis; three-dimensional; graphene aerogel; sulfur nanocrystals; lithium-sulfur batteries